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ABSTRACT

This paper documents how the University of Oklahoma developed discipline cost indices which it then used in its budget allocation process. In order to overcome the interinstitutional comparison problems between universities which use different reporting and accounting methods, discipline cost indices were derived using data collected through the Big Eight Data Exchange to permit better unit costs comparisons between academic disciplines from institution to institution. Discipline unit costs are expenditures per credit hour or expenditures per weighted credit hour. By means of a formula these discipline cost indices along with standard cost units and average cost per student credit hour were used to produce budget allocations for each department. The results were then compared with the preceding year's actual allocations for each discipline. The differences ranged from a decrease of 62.6 percent for geosciences to an increase of 22.3 percent for architecture. The explanation and verification of these discrepancies was an important part of the formula allocation process. The university did not fully implement the formula budget in the first year because of the large adjustments which would have been required. However, the process did receive wide recognition among the faculty and helped to articulate the university's strategic goals. Fourteen references and five tables are included. (JB)

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DISCIPLINE COST INDICES AND THEIR APPLICATIONS

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Jean Endo
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Discipline Cost Indices and Their Applications

Abstract

Differences in institutional reporting and accounting often reduce the comparability in expenditure data among institutions. This particularly affects interinstitutional comparisons of discipline unit costs, i.e. expenditures per credit hour or expenditures per weighted credit hour. To overcome this comparability problem, discipline cost indices have been developed to permit accurate interinstitutional comparisons of relative costs among disciplines. This paper documents how discipline cost indices have been derived, using expenditure data collected from five peer institutions, and how these indices have been implemented in a research university's budget allocation process. Institutional researchers and academic budget planners are the intended audience.

DISCIPLINE COST INDICES AND THEIR APPLICATIONS

Since early in the century, the literature on cost studies in higher education has consistently acknowledged the difficulty in making cost comparisons among institutions. Reasons cited for this difficulty include institutional differences caused by variation in accounting practices, uniqueness in missions, diversity in characteristics of educational programs, and incomparable measures and definitions of data required for cost studies. In addition to these problems, there is also a concern that comparisons of interinstitutional cost data fail to evaluate quality and efficiency of programs or institutions (Adams, Hankins, and Schroeder, 1978). Despite efforts to standardize cost data through various organizations, comparability remains a challenge in conducting interinstitutional cost studies. Today, institutions continue to recognize the importance and effectiveness in using comparative studies as a tool for internal budget management and as a basis for acquiring external funding (Rawson, Hoyt, and Teeter, 1983). The persistent demand for comparative data has continued to motivate efforts in the development and application of interinstitutional cost studies. This paper documents a recent effort at the University of Oklahoma (OU) in developing budget benchmarks based on discipline costs derived from the university's comparison institutions.

BACKGROUND

In 1989, the university president introduced a budget allocation model to establish the 1990-91 budget benchmarks for the academic units. The model was designed to provide incentives for the contributions made by each academic unit towards accomplishing the major strategic goals at the

university. The basic philosophy of this budget model is to allocate funds to each academic unit based on its performance in the past three years. The model specifies that 80% of the allocation is to be determined by outputs that are measured quantitatively; the other 20%, by outputs that are assessed qualitatively. The quantitative factors include the average outputs for the most recent three years in student credit hours (SCH), degrees, headcount majors, and amount of external funding in sponsored programs. The qualitative factors will be assessed according to each unit's progress against the university's strategic plan, its national reputation and visibility, and its importance to the university and/or the state.

The budget allocation guidelines further specify that the desired percentage distribution for each of the quantitative factors will be approximately 50% for SCH, 15% for degrees, 8% for headcount majors, and 7% for external funding in sponsored programs. The first step of the budget allocation process is to identify within each factor the associated dollar value per unit of output. In establishing these values, the budget allocation process becomes a mechanism that provides incentives for producing these outputs. The focus of this paper is on the method by which the associated dollar values for each SCH in various academic units have been derived.

Generally speaking, there are two sources from which per SCH funding by discipline may be calculated: internal cost studies, and interinstitutional cost comparisons. The per SCH funding for a discipline derived from internal cost studies usually reflects the past funding pattern of the discipline; it does not necessarily represent what the per SCH funding for the discipline should be. Therefore, using internal cost comparisons for departmental

budget allocation tends to perpetuate the historical funding pattern among the academic units. To avoid this type of bias, the decision was made to use cost data collected from comparable institutions to determine the per SCH funding level for each of the academic disciplines.

INTERINSTITUTIONAL COMPARISONS OF DISCIPLINE COSTS

The Source of Comparative Data

The data for the cost comparisons have been collected through the Big Eight Data Exchange (BEDE), a data exchange consortium established in 1981. The BEDE members are institutional research representatives from the Big Eight universities. Through the information exchange package developed by the consortium, the BEDE has provided a comprehensive data base for a variety of comparisons among the Big Eight universities. In addition to these comparisons, the BEDE members meet annually for firsthand information exchanges. There is also frequent communication among the BEDE members throughout the year. Because of the breadth of the information exchanged, the longevity of this data exchange program, and the network of communication among BEDE members, comparisons of any given topic can usually be interpreted within the context of other comparative studies and historical trends.

For comparisons of costs among academic disciplines, expenditures of nonrestricted funds for the academic units of each institution have been used as a primary data source. The data elements collected include expenditures of nonrestricted funds in academic salaries, support salaries, services, supplies, equipment, and computing. The expenditure data also include annual student credit hours for lower, upper, master's, and doctoral levels. The data are available for six of the eight BEDE institutions.

Evaluation of Cost Data from Comparison Institutions

The first step of the cost analysis is to review and document the overall consistency of the data collected. Since 1981 the results of the review each year have indicated that several discrepancies exist in cost data among institutions, despite continuous efforts in standardizing the definitions. Examples of these discrepancies include whether or not summer session is included, and how expenses in computing, equipment, services and supplies are reported. Another factor that affects comparisons at the discipline level is the way in which departments are organized into colleges. For example, the overhead cost in administration for an academic unit is usually smaller if the unit is part of a larger college. These differences need to be considered when evaluating the results of cost studies.

Reviewing the educational programs offered at each institution is the second step of the analysis. For comparability, only programs that match those offered at OU are selected for the cost study. The selected academic units for each institution are then organized into colleges using OU's college/department structure as a model. The process of mapping departments from comparison institutions into the structure of OU is documented and reviewed every year. The documentation is useful since changes in the component programs for a department may have an effect in the comparisons for that department and subsequently its college.

Third, before compiling the cost comparisons, the administration and organized research costs for a college are prorated to each department within the college based on the ratio of the department's total expenditures of nonrestricted funds. After the review, and the screening and matching of data, the stage is set for the first cost study.

Average Cost Per Student Credit Hour

The concept of unit cost has been introduced to compare costs in higher education since comparing total expenditures without making a linkage to the corresponding outputs is likely to produce information of limited use (Adams, 1978). Although there is no consensus in the literature on unit costing as to the best measurement of output, SCH has been the most frequently used denominator in deriving unit costs, particularly for costs in instruction. SCH was selected as the unit of measurement for this cost study which compares average expenditures by discipline in each of the six universities for the most recent three years. The 1988-89 summary of this study is shown in Table 1.

TABLE 1. 1988-89 Comparisons of Average Expenditures per SCH By Discipline Area
University of Oklahoma and Five Other Big Eight Universities

DISCIPLINE AREA	OU	COMPARISON INSTITUTIONS					
		A	B	C	D	E	Average
Architecture	\$126.20	\$178.58	\$136.53	\$117.34	\$172.24	\$116.14	\$148.67
Business Administration	89.01	74.14	95.30	64.42	90.31	62.32	75.29
Education	137.07	121.73	98.32	92.63	126.31	59.36	97.67
Engineering	183.92	207.92	152.39	199.22	207.42	164.84	202.46
Fine Arts	134.00	114.00	149.03	168.46	139.87	117.36	147.05
Geosciences	237.18	184.07	100.76	98.59	65.18	54.05	90.20
Mathematics	49.25	71.04	63.86	63.39	56.06	43.44	60.46
Professional Studies	83.31	78.76	60.97	112.48	111.38	50.23	92.08
Sciences	119.90	160.43	145.61	157.45	155.61	105.46	144.96
Social Sciences/Humanities	51.13	72.52	71.76	67.23	55.70	50.40	64.34
All Disciplines	94.54	100.72	91.61	95.67	96.05	69.80	93.06

Because of the discrepancies in reporting, interinstitutional

comparisons of average dollars expended per SCH for a discipline are not always meaningful. However, these differences do not preclude the possibility of producing valid comparisons. Adams (1978) pointed out that "Cost comparisons, whether unit cost or expenditure analysis, raise few issues of standardization if they are intrainstitutional or for a single unit over time." Similar observations were made later by Hample (1980): "The separation of costs into relevant fields or into departments is seldom a problem for an individual campus ... A greater challenge exists in conducting a study comparing costs among institutions." Therefore, while discipline costs in direct dollars may not be comparable across institutions because of reporting differences, internal cost comparisons among disciplines within an institution provide a reliable basis for interinstitutional comparisons of discipline costs in relative scales. The measures used for comparing relative costs among disciplines will be referred to as discipline cost indices.

Discipline Cost Indices (DCI)

A discipline cost index (DCI) is derived by dividing the cost per SCH for a discipline by the average cost per SCH for the entire institution. For example, if the cost per SCH in the mathematics department for an institution is \$60 and the average cost per SCH for the institution is \$100, the DCI for the mathematics department is 0.6 ($\$60/\$100$). The DCI for the overall institution's average cost per SCH is 1.0 ($\$100/\$100$). By definition, the DCI of the average cost per SCH for an institution is equal to 1.0 in all cases. Therefore, DCIs are standardized measures for comparing discipline costs per SCH among institutions. Table 2 displays the 1988-89 results of the second cost study, discipline cost indices of comparable discipline areas in the five comparison institutions and OU.

TABLE 2. 1988-89 Discipline Cost Indices by Area
University of Oklahoma and Five Other Big Eight Universities

DISCIPLINE AREA	OU	COMPARISON INSTITUTIONS					
		A	B	C	D	E	Average
Architecture	1.335	1.773	1.490	1.227	1.793	1.664	1.598
Business Administration	0.942	0.736	1.040	0.673	0.940	0.893	0.809
Education	1.450	1.209	1.073	0.968	1.315	0.850	1.050
Engineering	1.945	2.064	1.663	2.082	2.160	2.362	2.176
Fine Arts	1.417	1.132	1.627	1.761	1.456	1.681	1.580
Geosciences	2.509	1.828	1.100	1.031	0.679	0.774	0.969
Mathematics	0.521	0.705	0.697	0.663	0.584	0.622	0.650
Professional Studies	0.881	0.782	0.666	1.176	1.160	0.720	0.990
Sciences	1.268	1.593	1.589	1.646	1.620	1.511	1.558
Social Sciences/Humanities	0.541	0.720	0.783	0.703	0.580	0.722	0.691
All Disciplines	1.000	1.000	1.000	1.000	1.000	1.000	1.000

One of the advantages in using DCIs for comparing discipline costs among institutions is that the comparisons are not affected by interinstitutional differences in cost data. Another advantage is that DCIs permit cost comparisons to be made over time because their values are independent of inflationary changes. However, one remaining obstacle in this type of comparison is the lack of standardized cost factors to weight SCH of varying course levels. The SCH used in deriving the average unit cost for each discipline in this study reflect a different mix of course levels--undergraduate, master's or doctoral level--in each institution.

While attempts have been made to standardize the cost factors by disciplines for each instructional level, the results of these efforts reflect a wide range of disagreement among researchers as to what these factors should be (Bloom, 1983; NCHEMS, 1979; University of California,

Berkeley, 1954). A table quoted in Bloom's (1983) study, which compares nine sets of "Course-Level SCH Weighing Factors by NCES Discipline Area ..." from six states, clearly illustrates this wide range of differences. For example, when the weighing factor is set to 1.0 for a lower division SCH in each discipline, the weighing factors for graduate SCH in mathematics range from 2.45 to 14.43, and from 2.86 to 13.82 in psychology.

In the absence of a standard set of factors which may be used to weight SCH by level of instruction, the selection of institutions that are similar in educational programs and in the mix of instructional levels in these programs is particularly important when conducting cost comparisons. As an example, an analysis of the percentage of graduate level SCH for each discipline at OU and the comparison institutions is presented in Table 3 as part of this cost comparison. In the case where the percentage of graduate

TABLE 3. 1988-89 Discipline Cost Indices and Percentage of Graduate Level SCH
University of Oklahoma and Five Other Big Eight Universities

DISCIPLINE AREA	Discipline Cost Indices		% of Graduate Level SCH	
	OU	Comparison	OU	Comparison
Architecture	1.335	1.598	23.29%	15.21%
Business Administration	0.942	0.809	7.01	8.94
Education	1.450	1.050	43.42	40.14
Engineering	1.945	2.176	22.95	17.31
Fine Arts	1.417	1.580	10.54	6.29
Geosciences	2.509	0.969	16.61	6.54
Mathematics	0.521	0.650	2.36	4.87
Professional Studies	0.881	0.990	12.81	15.03
Sciences	1.268	1.558	7.12	10.90
Social Sciences/Humanities	0.541	0.691	4.11	5.43
All Disciplines	1.000	1.000	13.89	12.10

level SCH is higher at OU than the comparison institutions, the DCI of the comparison institutions understates the per SCH cost level required for OU. Conversely, if the percentage of graduate level SCH for a discipline is lower at OU than the comparison institutions, the DCI of the comparison institutions overstates the per SCH cost level required for OU.

THE APPLICATION OF DISCIPLINE COST INDICES

As stated previously, a DCI measures the relative unit cost of a discipline in comparison to the overall unit cost for the institution. A DCI of 3.0 for discipline A indicates that the cost per SCH for discipline A is three times that of the institution; a DCI of 0.5 for discipline B indicates that the cost per SCH for discipline B is half that of the institution. This means that if on the average, each SCH is equal to one cost unit, then each SCH in discipline A is equal to 3.0 cost units, and in discipline B, 0.5 cost units. Therefore, a DCI is a weighing factor which equates a SCH in a discipline to comparable cost units across disciplines. If the total SCH produced for discipline A and B is 1,000 each, the total cost units are equal to 3,000 ($1,000 \times 3.0$) for discipline A and 500 ($1,000 \times 0.5$) for discipline B. The cost units which have been standardized by the factors of DCIs will be referred to as standard cost units.

Standard Cost Units (SCU)

A standard cost unit (SCU) is defined as a cost unit which has been weighted by each discipline's cost factor, or its discipline cost index, to represent a unit of equal cost level. The DCIs of the five comparison institutions have been used as a set of discipline cost factors to standardize SCH in each of the disciplines at OU into equal cost units.

Equating SCH to SCU is, in essence, a process where funding is allocated in terms of units of cost, rather than dollar amounts. By using the average DCI in the five comparison institutions, the allocation results reflect the relative funding level for each discipline according to the cost model of these comparison institutions.

The following steps illustrate the process of the SCH based allocation at the University of Oklahoma.

- Step 1: Convert SCH in each discipline into standard cost units using the discipline cost indices derived from the cost analysis of the five comparison institutions.

$$SCU(d) = SCH(d) \times DCI(d)$$

(d): discipline of instruction

- Step 2: Summarize the total standard cost units in all disciplines.

$$SUM [SCU(d)] = SUM [SCH(d) \times DCI(d)]$$

- Step 3: Determine the amount of allocation per standard cost unit. The total SCH based allocation is equal to 50% of the total academic budget. The amount available for allocation is \$22.5 million.

$$\text{Dollar-Per-SCU} = \text{Total-SCH-Based-Allocation} / SUM [SCU(d)]$$

- Step 4: Derive the student credit hour based allocation for each discipline unit by multiplying the amount of allocation per SCU by the total number of SCU for the discipline unit:

$$SCH\text{-Based-Allocation}(d) = \text{Dollar-Per-SCU} \times SCU(d)$$

These four steps of the budget allocation process are documented in Table 4.

TABLE 4. FY 1990-91 SCH Based Allocation Using DCI of Comparison Institutions
University of Oklahoma

DISCIPLINE AREA	Student Credit Hours (SCH)*	Discipline Cost Indices (DCI)**	Standard Cost Units (SCH) x (DCI)	1990-91 Allocation \$42.88 x SCU
Architecture	14,668	1.625	23,836	\$1,022,088
Business Administration	60,977	0.791	48,233	2,068,231
Education	31,253	1.100	34,379	1,474,152
Engineering	45,280	2.065	93,503	4,009,393
Fine Arts	29,585	1.656	48,992	2,100,796
Geosciences	13,220	0.974	12,876	552,127
Mathematics	30,394	0.639	19,421	832,792
Professional Studies	48,135	1.002	48,231	2,068,158
Sciences	56,695	1.508	85,496	3,666,060
Social Sciences/Humanities	154,800	0.709	109,753	4,706,204
All Disciplines	485,006		524,720	\$22,500,000

Step 1: $SCU(d) = SCH(d) \times DCI(d)$

Step 2: $\text{Sum } [SCU(d)] = \text{Sum } [SCH(d) \times DCI(d)] = 524,720$

Step 3: $\text{Dollar-Per-SCU} = \text{Total-SCH-Based-Allocation} / \text{Sum } [SCU(d)] = \$22,500,000 / 524,720 = \$42.88$

Step 4: $SCH\text{-Based-Allocation}(d) = \text{Dollar-Per-SCU} \times SCU(d) = \$42.88 \times SCU(d)$

* SCH for undergraduate, master's, and doctoral level are weighted by the factors of 1.0, 1.5, and 3.0 respectively.

** The discipline cost indices represent the averages for the most recent three years: 1986-87, 1987-88, and 1988-89.

Evaluating the Budget Benchmarks

After the initial distribution by the formula, the allocation is then compared with the current year's budget to evaluate the extent of reallocation that would be required in order to implement the formula budget. Table 5 displays the differences in the 1990-91 SCH based allocation (50% of the total academic budget) for each discipline unit, and the allocation according to each discipline unit's actual share of the 1989-90 budget.

TABLE 5. Comparisons Between Formula Allocation and Actual Allocation
University of Oklahoma

DISCIPLINE AREA	METHODS OF ALLOCATION		Percentage Difference
	1990-91 Formula Allocation	1989-90 Actual Allocation	
Architecture	\$1,022,088	\$835,478	22.3%
Business Administration	2,068,231	2,886,016	-28.3
Education	1,474,152	1,511,359	-2.5
Engineering	4,009,393	3,555,304	12.8
Fine Arts	2,100,797	1,808,778	16.1
Geosciences	552,127	1,476,490	-62.6
Mathematics	832,792	876,255	-5.0
Professional Studies	2,068,158	1,836,367	12.6
Sciences	3,666,060	3,468,866	5.7
Social Sciences/Humanities	4,706,204	4,245,085	10.9
All Disciplines	\$22,500,000	\$22,500,000	-

As illustrated in Table 5, there is a wide range of differences between the actual budget and the formula budget for the discipline units. The differences range from a decrease of 62.6% for geosciences, to an increase of 22.3% for architecture. The explanation and verification of these discrepancies is a very important part of the formula allocation process. The evaluation of the allocation in geosciences is provided as an illustration.

The difference of -62.6% for geosciences is the largest among the disciplines. There are several factors which contribute to this difference. First, enrollment in geosciences has decreased by almost 50% since 1982. Primarily as a result of the decrease in enrollment, the per student funding

in geosciences from FY 1982 to FY 1990 rose in real terms by 61%. Second, teaching load comparisons in the past three years indicated that SCH per FTE instructional faculty in geosciences at OU was at the 50% level when compared with the five comparison institutions in the Big Eight; studies of teaching load in the Southern University Group (SUG-25) also indicated similar results. Third, the percentage of graduate students in the geosciences disciplines at OU is 16.6% compared with 6.5% in the comparison institutions (Table 3). The DCI for the geosciences disciplines in the comparison institutions, therefore, understates the level of funding required when applied to the enrollment at OU. Fourth, this portion of the allocation is based on the output of SCH alone. The strength of geosciences is in sponsored research; meteorology and geology are prominent research departments.

These rationales derived from trend data and interinstitutional comparisons help explain and verify the difference between the actual budget and the formula budget in the geosciences disciplines. This evaluation is a crucial step in the formula budgeting process because the observations made in the process contribute to the final outcome of the allocation.

The Implementation of the Formula Budget

The formula budget was not fully implemented at OU in the first year that it was introduced because of the magnitude of the reallocation that would have been required. The 1990-91 budgeting method at OU was largely incremental. Ninety percent of the increase in funding for academic units was allocated for incremental increases in salaries; the other 10% was used to distribute additional incentive funds as identified by the formula budget

and the evaluation process.

Despite the fact that only a small percentage of the budget was allocated based on the results of the formula, the budget model received wide-spread recognition among the university's faculty. The 1990-91 budget allocation model at OU moved the budgeting approach from "... incremental budgeting, where little attention was typically paid to planning, to formula budgeting which specified planned relationship" (Orwig and Caruthers, 1980). The process appeared to have been a successful one in that OU's strategic goals were effectively articulated to the university community.

CONCLUSION

As institutions experience an increasing need to reallocate resources in order to meet the realities of enrollment decline and shrinking resources available for higher education, there will also be an increasing demand to use cost comparisons as an analytical tool for resource management. A survey of the literature on cost studies indicates that collecting comparable interinstitutional cost data remains a challenge even though much effort has been expended by various organizations in standardizing the definitions of cost data and accounting guidelines (Hample, 1980). The following is a list of the common problems that have been observed:

1. The components of the expenditures reported vary from institution to institution. The categories of expenditures for an academic unit include a wide range of items: faculty salaries, staff salaries, supplies, services, travel, equipment, computing, etc. Depending on the accounting practices at institutions, the data may or may not include all the expenditure categories.

2. "Cost differences also may be explained to a minor extent by location in urban or rural settings, by location in different sections of the country, and by size of institution" (Bowen, 1980).
3. Cost comparisons often do not take into account institutional quality. Therefore, cost data from different institutions may reflect different levels of quality in their associated outputs.

Although these problems do have an effect on the cost comparisons of disciplines in direct dollars across institutions, they do not affect the consistency of internal cost comparisons among disciplines. Therefore, DCI has been introduced as a solution to these problems because it compares discipline costs among institutions in relative scales rather than direct dollars. The concept of DCI was developed based on the theory that each individual institution's internal comparisons of relative costs among disciplines are derived from consistent cost data which follow the same accounting guidelines for the institution. DCIs are measures of discipline costs independent of interinstitutional differences and inflationary changes over time. The fact that DCI is an independent measure of discipline cost makes its application a flexible process for evaluating the resource requirements for various disciplines.

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